How Native Japanese Speakers Solve Ambiguous Relative Clauses in Their L1 and L2: Evidence from the Self-paced Reading of Japanese and English*

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Abstract
The present study combined off- and on-line tasks to demonstrate how L1 Japanese late intermediate learners of L2 English specify an antecedent of a relative clause (RC) in L1 Japanese and L2 English. When an RC has two candidate antecedents, it is reported that native English speakers prefer attaching an RC to a closer noun phrase (CNP) to itself (*recency preference*, RP), whereas native Japanese speakers prefer attaching an RC to the most distant noun phrase (DNP) from itself (*predicate proximity*, PP). Responses to a questionnaire that was administered as part of this study showed a similar preference with regard to RC attachment in L1 Japanese and L2 English. However, in the self-paced reading task, the reading time of RCs semantically biased to DNPs was longer than that of neutral RCs in L2 English, indicating a conflict between RP and PP during the processing of L2 English. The results suggest that native Japanese speakers learning English may unconsciously transfer their attachment principle in L1 Japanese to L2 English.

Key words
Relative clause, ambiguity, Japanese, English, L2 acquisition

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1. Introduction

Second language (L2) learners have difficulty comprehending ambiguous relative clauses (RC) of the target language (TL), as this requires the application of a principle different from that used for their first language (L1). An RC can be ambiguous when it has two candidate antecedents, such as multiple noun phrases (NPs) connected by a genitive marker like (1) given below. This is especially the case when both NPs (i.e., *the teacher* and *the student*) are equally plausible (neutral) as the agent of the action described in the RC (i.e., *walking in the park*) as shown in (1a), rather than when one NP (i.e., *the student*) is more plausible as experiencing the event (i.e., *failed in the test*) than the other (i.e., *the teacher*) as shown in (1b).

(1) a. Kooen o aruiteiru sensei no seito o Misaki ga warawaseta
Park in walking teacher GEN student ACC Misaki NOM amused
'Misaki (person's name) amused the teacher of the student who was walking in the park.'

b. Tesuto de rakudaishita sensei no seito o Misaki ga warawaseta
test in failed teacher GEN student ACC Misaki NOM amused
'Misaki amused the student of the teacher who failed at the test.'

Predicting which NP should be the antecedent of the RC differs among languages, according to the following two principles: the principle of *Recency Preference* (RP), which preferentially attaches structures for incoming lexical items to structures built more recently (Gibson, Pearlmutter, Gonzalez, and Hickok 1996:26), and the principle of *Predicate Proximity* (PP), which attaches as close as possible to the head of a predicate phrase (Gibson et al. 1996:41). It is known that the preference interferes with the semantic plausibility of NP as the antecedent of the RC (e.g., Felser, Roberts, and Marinis 2003, Yamada, Arai, and Hirose 2016).

Influences of these principles on L1 sentence processing have been investigated based on reading time (RT) data obtained from a self-paced reading (SPR) task (Gibson et al. 1996), where L1 speakers of English and Spanish read sentences including three NPs followed by an RC, when all the NPs were assumed to be equally semantically plausible (i.e., neutral) as the RC antecedent. Their RT data revealed that both the L1 speakers' sentence processing with RC was influenced by both RP and PP, but at the same time suggested that English L1 speakers were in line with RP as they tended to attach the RC with the closest NP (CNP), while Spanish L1 speakers preferred PP, as they tended to attach the RC to the most distant NP (DNP). The relative strength of PP in comparison with RP, like Spanish, has also been demonstrated in German (Hemforth, Konieczny, and Scheepers 2000), Greek (Papadopoulou and Clahsen 2002), and Japanese (Kamide et al. 1997, Miyamoto, Gibson, Pearlmutter, Aikawa, and Miyagawa 1999, Miyamoto, Nakamura, and Takahashi 2004) as having the tendency to attach the given RC to DNP.

The preference between RP/PP principles could affect L2 learners' sentence processing, especially if they have conflicting preferences between L1 and L2. In order to examine whether L2 learners select different principles among languages, Felser, Roberts, Marinis, and Gross (2003) conducted a questionnaire survey to ask German and Greek L1 speakers, who were supposed to adopt PP, to make judgment of sentences including two NPs with an ambiguous RC like (1), in their L2 English which is known to comply with the RP principle. Results did not indicate a significant or particular preference among these L2 English learners, despite the fact that they were fully proficient in the L2. They selected both CNP and DNP as the antecedent of

the ambiguous RC almost equally, unlike L1 English speakers, who preferred CNP to DNP. It is obvious that L2 learners with PP preference do not process ambiguous RCs in the same way as L1 English speakers do. Further, the extent to which L2 learners' age of acquisition modulates the RC attachment preference in the TL has been investigated using a questionnaire survey (Fernández 1999), indicating late L2 English learners' stronger bias (as compared to early learners) toward PP, which is the attachment principle preferred in their L1 Spanish. Therefore, the interference between the two RC attachment principles is supposed to be more severe in late L2 learners when they have different preferences between L1 and L2.

While many studies have utilized off-line experiments such as an acceptability judgment task and a picture-sentence matching task, to examine participants' explicit knowledge about how to interpret sentences, more advanced techniques of on-line tasks such as the SPR as well as word-monitoring allow us to better understand the participants' unconscious and automatic reaction to language stimuli (Marinis 2010). The study of Cuetos and Mitchell (1988) was one of the earliest to combine the off- and on-line tasks to differentiate how English and Spanish L1 speakers process sentences with an ambiguous RC like (1). Their multifaceted examination utilizing SPR as well as acceptability judgment particularly shed light on the incremental process of the PP preferences in Spanish RC comprehension. However, it still remains unclear how the RC attachment is modulated between L1 and L2 within a speaker, in a situation where the L1 and L2 are assumed to have conflicting RC attachment preferences of RP and PP.

Taken together, the present study combined the off-line (i.e., RC attachment judgment by using a questionnaire) and on-line (i.e., SPR) tasks to demonstrate how L1 Japanese speakers who began learning L2 English after the L1 acquisition (i.e., late learners) specify two NPs as the antecedent of the given RC between their L1 (Japanese) and L2 (English). In order to elucidate the degree to which RP and PP influence their RC attachment between the two languages, we examined the incremental processing of sentences with ambiguous RC, in terms of whether both NPs are equally semantically plausible as the antecedent of the RC (i.e., *neutral* as in 1a), or whether a DNP is more plausible to be the RC antecedent than a CNP (i.e., *DNP-preferred* as in 1b). We predicted as follows: L1 Japanese speakers consistently process sentences with the ambiguous RC on the basis of the PP principle, regardless of the semantic plausibility (neutral or DNP-preferred), while they apply RP when processing RCs in L2 English, as they have explicitly learned the principle in the TL as applicable in the intermediate level. Nevertheless, they might still experience difficulty with the implicit automatic processing of RC based on RP in L2 English, as they are late learners who are not yet highly proficient, which could yield a greater cost reflected in RT when they are engaged in on-line processing. This should be more evident in the DNP-preferred RC than neutral one, because the DNP attachment conflicts with the RP principle.

2. Methods

2.1. Participants

A total of 40 graduate and undergraduate students (mean age 20.9, range 18-22, 17 females) of a national university in Japan participated in the experiment. The participants' native language was Japanese. All of them, except one, had no experience living in English-speaking areas for more than six months. Assessed using the Online Oxford Placement Test (OOPT; Purpura 2010), the English levels in terms of the Common European Framework among the majority of the participants (52.5%) were intermediate B1 and B2. The rest of them were assessed as A2 (12.5%) or C1 (10.0%), or could not be assessed (due to the failure of an appropriate item

assignment in the OOPT; 25.0%). Given the fact that all had passed the same entrance examination of one university, it is obvious that most of the participants were at the intermediate level of L2 English. They were paid for their participation. This study was approved by the ethical committee of the Graduate School of Arts and Letters of Tohoku University, Japan.

2.2. Stimuli

We prepared a total of 32 target stimuli transitive sentences including an RC in each Japanese sentence with subject-object-verb (SOV) word order and English sentence with subject-verb-object (SVO) word order. Japanese stimulus sentences had the word order of RC-CNP-GEN-DNP-S-V, while English sentences had S-V-DNP-GEN-CNP-RC. Half of them included a neutral RC like (1a) and the other half included a DNP-preferred RC like (1b). The two conditions of the RC semantic plausibility were normed based on a pilot study by 36 native Japanese speakers (mean age 20.4, 17 females) who did not participate in the off- and on-line tasks. The RC conditions were counterbalanced across the two languages. In addition to the target stimuli, 16 filler sentences were also created. The contents of the sentences were equivalent between the two languages. Those sentences were first created in Japanese, and then translated into English by several native Japanese and English speakers.

2.3. Procedure

The experiment took two days. The participants completed OOPT on Day 1 to assess their L2 English proficiency, and underwent the off- and on-line tasks of the RC comprehension in Japanese and English on Day 2 after at least a one-day interval from since Day 1.

Off-line task

Using a paper-and-pencil questionnaire, the participants were asked to read the whole sentence and judge which NP was the antecedent of the RC, by putting a tick next to one of the two options of the CNP and DNP.

On-line task

The participants were seated in front of a computer monitor and asked to read the stimulus sentences region by region like (2), by pressing the space key as soon as possible once they understood the region (i.e., self-paced).

(2) a. Japanese sentences (RC | NP (CNP-GEN-DNP) | S | V)

kooen-o	arui-teiru	|	sensei-no	seito-o	|	Misaki-ga	|	warawase-ta.
park-in	walking	|	teacher-GEN	student-ACC	|	Misaki-NOM	|	amused
RC		|	NP		|	S	|	V

b. English sentences (S | V | NP (DNP of CNP) | RC)

Peter	|	amused	|	the student of the teacher	|	who was walking in the park.
S	|	V	|	NP	|	RC[1]

[1] The vertical lines (|) represent regions presented at once in the SPR task.

Each region was presented in the center of the monitor. Following the stimulus sentence, participants recorded their judgment about the RC attachment; they did this by using a button press feature to answer questions such as “Was the teacher walking in the park?”. A practice session consisting of 10 trials was utilized to familiarize the participants with the SPR task. This was carried out before they completed the off-line task described in the previous section, to avoid a repetition effect. E-prime ver. 2.0. (Psychology Software Tools, Sharpsburg, PA) was used to present the stimuli and to record the behavioral data.

2.4. Analysis

Off-line task

A chi-squared test was performed in each language to examine whether the frequency of the selected antecedent (CNP/ DNP) of the RC differed between the two conditions (neutral / DNP-preferred RC).

On-line task

A series of linear mixed effects (LME) models (Baayen, Davidson, and Bates 2008) were conducted using packages *lme4* (Bates, Maechler, Bolker, and Walker 2015) and *lmerTest* (Kuznetsova, Brockhoff, and Christensen 2018) within R version 3.5.1 (R Core Team 2018). We set NP in L1 Japanese (Kamide and Mitchell 1997, Miyamoto et al. 1999) and RC in L2 English (Felser, Roberts, Marinis, and Gross 2003) as the region of interest (ROI), where participants were supposed to solve the ambiguity. The RT of each ROI was included as a fixed effect. In addition, to differentiate a spillover effect, the RT of the region(s) before the ROI was also included as a fixed effect of no interest. The effects of participant and item were treated as random effects.

3. Results

Off-line task

A significant difference was found in the preference of RC attachment depending on whether the RC condition was DNP-preferred or neutral, both in L1 Japanese and L2 English. The ratios of RC attachment to DNPs were significantly higher in a sentence with a DNP-preferred RC than that with a neutral RC in both L1 Japanese (χ^2 = 54.425, p = .000, ϕ = -.290, Fig. 1) and L2 English (χ^2 = 55.983, p = .000, ϕ = .300, Fig. 2).

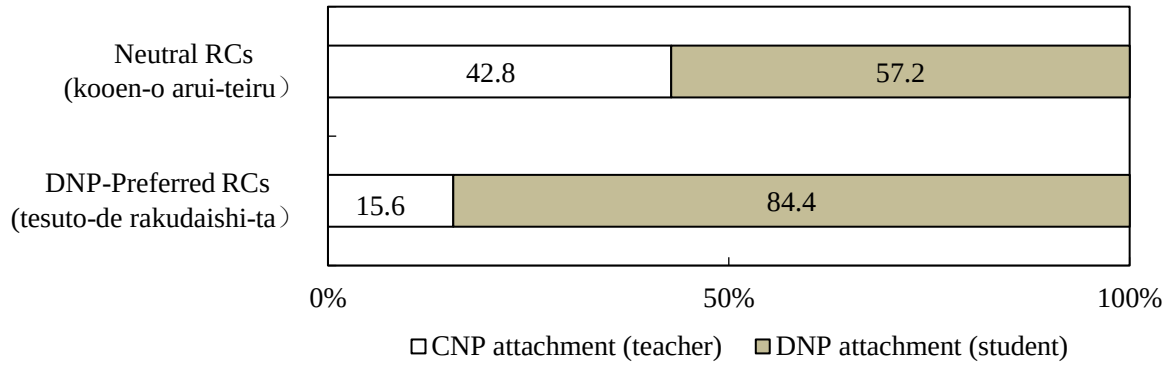

Figure 1: Attachment preference in L1 Japanese (off-line)

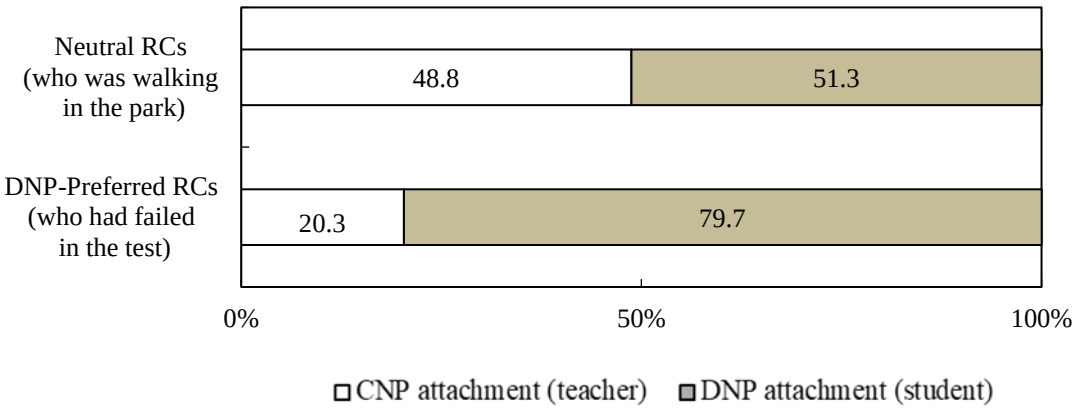

Figure 2: Attachment preference in L2 English (off-line)

On-line task

As summarized in Table 1, the RC conditions showed no significant effect on RT of NPs in L1 Japanese (Fig 3.). Contrarily, in L2 English, the RT of DNP-preferred RCs was marginally longer than that of neutral RCs (Fig 4.).

Table 1. LME results of the SPR task in L1 Japanese and L2 English

	β	*LL* 95% CI	*UP* 95%CI	*t*	*p*	
L1 Japanese SPR task						
NP						
(Intercept)	0.003	-0.241	0.248	0.025	0.980	
RC condition	0.065	-0.116	0.245	0.726	0.473	
RT of the previous region	0.125	0.029	0.223	2.585	0.010	**
Interaction	0.002	-0.112	0.115	0.027	0.978	
L2 English SPR task						
RC						
(Intercept)	0.093	-0.170	0.366	0.698	0.488	
RC condition	-0.239	-0.515	0.034	-1.747	0.088	†
RT of the previous region	0.258	0.054	0.462	2.549	0.011	*
Interaction	0.003	-0.238	0.244	0.026	0.979	

Note. β, LL, UP, CI refer to standardized regression coefficient, lower limit, upper limit, and confidence interval, respectively. ** $p < 0.01$. * $p < 0.05$. † $p < 0.1$.

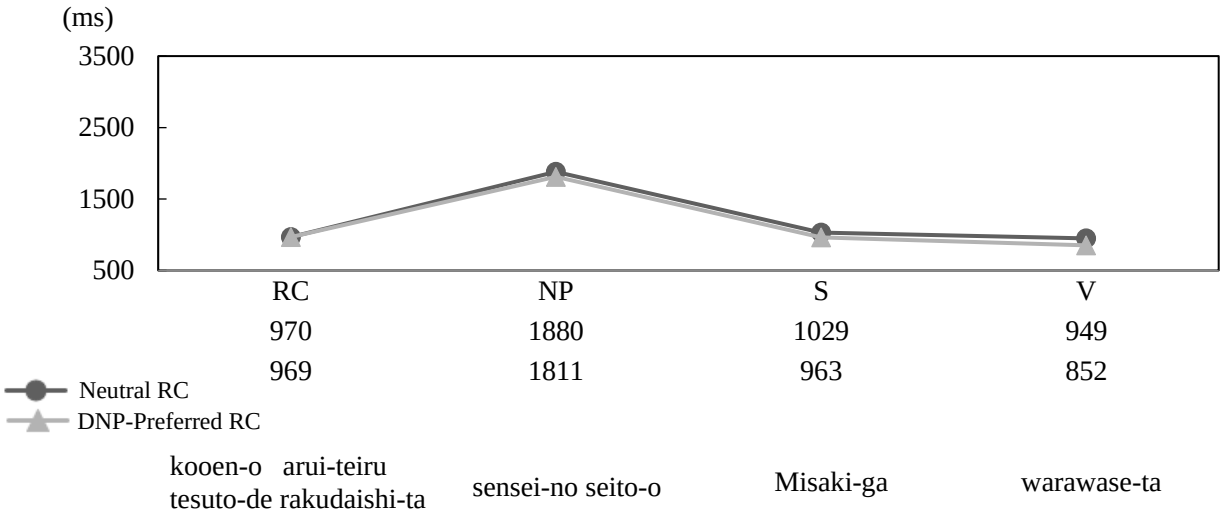

Figure 3: RT of each region in Japanese SPR

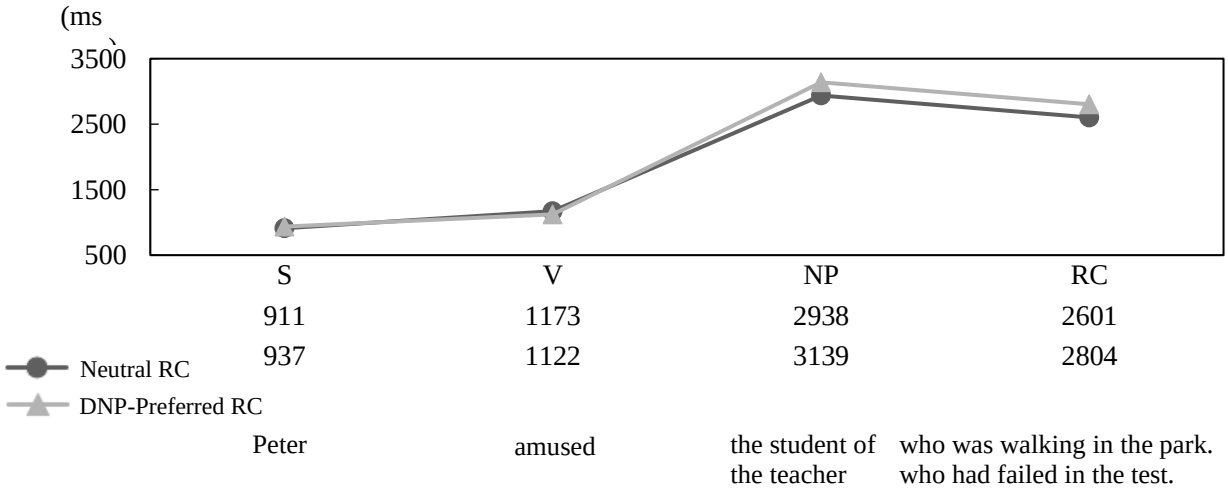

Figure 4: RT of each region in L2 English SPR

4. Discussion

The present study aimed to examine how L1 Japanese speakers solve sentences with an ambiguous RC, including multiple semantically plausible NPs in their L1 and L2 English. Our analyses found our Japanese participants' inconsistent preferences between the off- and on-line tasks across the two languages.

The off-line task revealed that the L1 Japanese late intermediate learners of L2 English made a similar RC attachment in the both languages, such that they had no specific preference for CNP or DNP as the antecedent of the neutral RC. However, they preferred DNP as the antecedent of the DNP-preferred RC, by applying the PP principle. This result is consistent with Felser et al.'s (2003) report of off-line tasks, revealing that L1 German and Greek advanced learners of L2 English tend to follow PP in the TL as well as in their L1s, despite their L1 English speaking

participants showed an RP preference. The present finding suggests that, like German and Greek speakers, native Japanese speakers transfer the PP principle in their L1 to comprehend the ambiguous RC in the L2.

On the other hand, the on-line task found the L1 Japanese speakers' marginally greater processing load especially for solving the DNP-preferred RCs than the neutral RCs in L2 English, whereas no significant difference between the two RC conditions in the L1. This finding suggests that L1 Japanese learners of L2 English with intermediate proficiency are confused by the conflicting principles; that is, their inherent persistence with the PP principle induced by DNP-preferred RC may conflict with their explicit L2 knowledge that English RC attachment should be solved by the RP preference. In other words, this might reflect Japanese learners' unconscious linguistic transfer from the PP in L1 to the RP in L2 for solving the ambiguous RC.

Nevertheless, the present study has some methodological limitations, some of which should be elaborated in future studies. First, our on-line SPR task presented each region in the center of the screen, instead of the moving-window presentation paradigm. This environment might have obscured the participants' natural reading processes. Second, all of our participants underwent the both on- and off-line tasks in the same order of L1 Japanese and L2 English on the same day, which could have induced some repetition bias especially in L2 English. Further replication studies to compare L2 learners' explicit knowledge and implicit processing for the ambiguous RC, with more elaborate methods, will provide insights into how they learn to control the two conflicting principles of RP and PP between L1 and L2.

5. Conclusion

The present cross-linguistic combined study of on- and off-line tasks concludes that L1 Japanese late intermediate learners of L2 English are still learning to control the conflicting principles of RC attachment between the PP and RP, especially during their on-line incremental processing of L2. They might unconsciously transfer the PP principle in their L1 Japanese to the RC attachment in L2 English which has been known to comply with the RP principle.

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